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AUTHOR Filan, Gary; Sullivan, Howard
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ABSTRACT

In this study of children's memory, two types of presentation modes (pictures or words) were crossed with two levels of memory strategy ("make a picture in your mind" or "think of the word") to comprise four treatments: see picture/think picture, see picture/think word, see word/think picture, see word/think word. The study was conducted with 144 second graders across three reading levels from a suburban public school. Stimuli were 40 words chosen from the concrete nouns in the Pavio, et al. (1968) list and simple line-drawing visuals representing each word. Stimuli were slide projected onto a screen for three seconds. After each slide the screen was blank for three seconds to allow subjects to think according to instructions of the object or word. A randomly ordered and counterbalanced criterion test composed of 40 multiple-choice items--20 word items and 20 picture items--was administered two minutes after presentation and again in alternate form after three days. Results for memory strategy, presentation mode, reading level, test mode, immediate and delayed test performance, and variable interactions are presented. The data indicate that memory is better for pictures than for words in both immediate and delayed tests, but the "think picture" strategy was not effective on the delayed test. Low reading group subjects, who had used the "think word" strategy performed slightly better than "think picture" counterparts on the immediate test and substantially better on the delayed test. (Author/RH)

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*EFFECTS OF INDUCED MEMORY STRATEGIES ON CHILDREN'S MEMORY FOR PICTURES AND WORDS

Gary Filan and Howard Sullivan
Arizona State University

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Introduction

A rather common explanation for children's superior memory for pictures over words is that a picture stimulus also calls to mind the equivalent word (for example, the subject sees a picture of a dog and thinks the word "dog"), whereas a word stimulus is less likely to call to mind its equivalent stimulus in a pictorial or other physical form (Paivio, 1971). Thus, it is reasoned, individuals exposed to a picture may encounter the object in both picture and word form, but individuals exposed to a word may encounter it only in word form.

A recent study by Sullivan and Filan (1979, Note 1) raises questions about the adequacy of the above explanation. Subjects presented with simple words and instructed to "make a picture in your mind of the thing the word stands for" presumably encountered each word in both word and picture form, yet their mean posttest score was significantly lower than that of subjects under a "pictures-no imagery" treatment.

The present study was designed to investigate children's memory for picture and word stimuli under two induced mental strategies -- either thinking of the object or thinking of the word. Presentation mode was crossed with mental strategy so that half of the Ss were instructed to think of the item in the same mode in which it was presented, and half were instructed to think of it in the opposite mode. Thus, under the experimental conditions half of the Ss were presumably exposed to an item in both picture

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and word forms, while the other half were exposed to it in one form only. Memory was assessed on both an immediate test and a delayed test. The study was conducted with second graders across three reading levels.

Method

Subjects

Subjects were 144 second graders (median age = 8.4) from a suburban public school.

Stimulus Materials

Stimuli were 40 words chosen from the concrete nouns in the Paivio, et al (1968), list and simple line-drawing visuals representing each word. All words were at the AA or A frequency in the Thorndike-Lorge (1944) word list and had previously been taught at levels of the basic reading program completed by all Ss. In the judgment of participating teachers, all words were well within the reading repertoire of all Ss. The learning materials, consisting of either a single printed word or its pictorial equivalent per stimulus item were produced in the form of 2" x 2" slides. The slides were randomly ordered, with the same order being used for both the 40 word slides and the 40 picture slides.

Procedures

The two levels of presentation mode (pictures-words) were crossed with two levels of memory strategy ("make a picture in your mind" or "think of the word") to comprise four treatments: see picture-think picture, see picture-think word, see word-think picture, see word-think word. Ss were classified by their teachers into three reading levels (high, middle, low) with equal Ns at each level and were randomly assigned within each reading level to

treatment groups. Treatments were administered by trained experimenters (Es) to intact treatment groups containing a total of 12 Ss from across the three reading levels.

Ss under the "see word-think word" condition were given the following instructions:

> "I am going to show you some words on slides today. You should try very hard to remember each word."
>
> "Here's how to do it: First look at the word. Then when the word goes off the screen, think of the word in your mind. Do this for each word."
>
> "After I show you the words, we are going to see how many words you can remember. You can show me what good memories you have."

Instructions for Ss in the "see picture-think picture" condition were virtually identical to those for Ss in the "see word-think word" condition, except that "picture" was substituted for "word" throughout the instructions. The "see picture-think picture" instructions are shown below, with changes from the "see word-think word" instructions underlined.

> "I am going to show you some pictures on slides today. You should try hard to remember each picture."
>
> "Here's how to do it: First look at the picture. Then when the picture goes off the screen, make a picture of the object in your mind. Do this for each picture."
>
> "After I show you the pictures, we are going to see how many pictures you can remember. You can show me what good memories you have."

Instructions for the "see word-think picture" condition were identical to those for the "see word-think word" condition except that "make a picture in your mind of the thing that the word stands for" was substituted for "think of the word in your mind." Instructions for the "see picture-think word" condition were identical to those for the "see picture-think picture" group except that "think of the word that the picture stands for" was substituted for "make a picture of the object in your mind."

The slides were projected with an automatic advance carousel-type

projector onto a screen at the front of the classroom. The projector was programmed to display each slide for three seconds, followed by a three-second blank-screen period for thinking of the object or word. The time periods were derived on the basis of preliminary tryouts with small groups of subjects.

Immediately prior to showing of the 40 experimental items, each group of Ss was given practice in its particular learning strategy through use of four example items in the stimulus form (word or picture) appropriate to the treatment group. After four pre-selected slides (Slides 5, 15, 25, and 35) in the 40-item sequence, E made a brief comment such as: "Don't forget to make a picture of each object in your mind" or "Think of the word in your mind." The comments were intended to remind Ss of the strategy they were to use and to keep their attention focused on the task. A one-minute rest break, during which Ss stayed in their seats without talking, was given after Slide 20.

Criterion Test

The criterion test was composed of 40 multiple-choice items -- 20 word items and 20 picture items. Each item consisted of a correct choice (the word or its picture equivalent from the presentation phase) and two distractors, which also were from the Paivio, et al., list and the AA or A frequency level in Thorndike-Lorge. Thus, Ss responded to 20 items that were in the same mode (word or picture) in the test as they were in the Ss particular presentation mode and to 20 items in the opposite mode. The test was constructed in two forms: one in which the 20 randomly ordered word items preceded the 20 randomly ordered picture items, and a second in which the word-picture form and sequence were reversed. Test forms were counterbalanced across treatment conditions.

The initial criterion test was administered immediately following a two-minute break at the end of the presentation phase. The alternate form (i.e., for each S the form not taken as the immediate test) was administered as a retention test three days later.

Design and Data Analysis

A 3 (reading levels) x 2 (presentation modes) x 2 (memory strategies) x 2 (test modes) factorial design was employed. The first three factors were between-subjects variables. Test mode was a within-subjects variable. Data were analyzed using a 3 x 2 x 2 x 2 univariate and multivariate analysis of variance for both the immediate and delayed tests.

Results

Mean scores on the immediate and delayed tests are shown in Tables 1 and 2 respectively. The summary table for the univariate ANOVA is presented in Table 3. Results are discussed below by treatment and criterion factors.

Memory Strategy

On the 40-item immediate test, the overall mean score of 33.17 for Ss under the "think picture" condition was significantly higher than the mean of 31.03 for Ss under the "think word" condition, $F(1,132) = 8.72$, $p < .01$. The mean score of 31.77 for Ss whose treatment conditions were in two modes (see picture-think word and see word-think picture) was slightly, but not significantly, lower than the mean of 32.43 for Ss whose conditions were in one mode only.

On the delayed test, overall means were 25.00 for the "pictures" memory strategy and 24.15 for the "words" strategy -- a non-significant difference. Thus, the significant positive effect favoring the "think pictures" strategy on the immediate test did not occur on the delayed test. The mean score

(23.89) of Ss whose treatment conditions were in two modes was again lower than the mean (25.27) of Ss whose conditions were in one mode only.

Presentation Mode

The overall mean score on the 40-item immediate test was 33.27 for Ss under "picture" presentation mode and 30.93 for Ss under the "word" mode. The difference favoring the picture mode was statistically significant, $F(1,132) = 10.38$, $p < .01$.

Mean scores on the delayed test were 26.39 for the picture mode and 22.77 for the word mode. As on the immediate test, the difference favoring the picture mode was signifi[illegible] $F(1,132) = 15.35$, $p < .001$.

Reading Level

The mean scores by reading level on the immediate test ranged from 30.68 for the low group to 32.99 for the high group. As expected, a significant difference was obtained for reading level, $F(2,132) = 3.87$, $p < .05$. Individual comparisons revealed that the mean scores of the high and middle groups did not differ significantly, but that each of these two groups scored significantly higher than the low reading group.

Mean scores by reading level on the delayed test ranged from 21.98 for the low reading group to 26.25 for the high group and again differed significantly across levels, $F(2,132) = 8.76$, $p < .001$. As on the immediate test, there was not a significant difference between the scores of the high and middle reading groups, but each of these groups scored significantly higher than the low group.

Test Mode

Mean scores on the two test modes were very similar on both the immediate and delayed tests. The mean scores on the immediate test were

16.10 on the 20 picture items and 16.00 on the 20 word items. Mean scores on the delayed test were 12.22 on picture items and 12.36 on word items.

Immediate and Delayed Test Performance

As expected, performance declined from the immediate test to the delayed test. The grand mean for the 40-item immediate test was 32.10, as contrasted with a mean of 24.58 for the delayed test. The delayed test yielded patterns of differences that were very similar to those on the immediate test. Of the seven significant differences (three main effects and four interactions) obtained on the immediate test, as shown in Table 3, four were also obtained on the delayed test. However, the other three significant differences on the immediate test were not maintained on the delayed test. There were no cases in which a non-significant difference occurred between groups on the immediate test, but in which a significant difference was found on the delayed test.

Interactions

The most powerful interaction was a presentation mode by test mode effect obtained on both the immediate and delayed tests. This effect may be observed by examining the "Totals" column for pictures and words in Table 1 and/or Table 2. On the immediate test as shown in Table 1, the total scores for the picture presentation mode (Rows 1 and 2) are higher on picture test items (18.36 and 16.83) than on word test items (16.31 and 15.03). Conversely, the totals for the word presentation mode (Rows 3 and 4) are higher on the word test items (16.70 and 15.97) than on the picture items (14.97 and 14.22). A similar pattern occurred in the delayed test, as shown in Table 2. Significant presentation mode by test mode interactions were obtained for both tests: $F(1,132) = 81.16$, $p < .0001$ for the immediate test and $F(1,132) = 57.42$, $p < .0001$ for the

delayed test. These interactions reflect a pattern in which Ss under the picture presentation mode perform better on picture test items, whereas Ss under the word presentation mode perform better on word test items. This pattern was consistent across reading level, memory strategy, and time of testing (immediate and delayed).

A significant interaction on both the immediate and the delayed test also was obtained for memory strategy by reading level: $F(2,132) = 4.63$, $p < .05$ for the immediate test and $F(2,132) = 6.06$, $p < .01$ for the delayed test. This interaction is a result of the "think picture" strategy being more effective with high readers and the "think word "strategy being more effective with low readers.

Two significant interactions were obtained on the immediate test but did not occur on the delayed test. A presentation mode by strategy by reading level interaction reflected better performance by low readers under the "think picture" strategy in the picture presentation mode and under the "think word" strategy in the word presentation mode. A presentation mode by reading level by test mode interaction indicated that high readers scored better on word test items under the picture presentation mode than under the word mode, whereas middle and low readers scored better on word test items under the word presentation mode.

Discussion

The present study provides further data that call into question the adequacy of Paivio's (1971) coding redundancy hypothesis. According to this hypothesis, subjects who use a memory process that involves both a visual and verbal encoding system should perform better on memory tasks than individuals who use a process involving only one system. If this

explanation were correct, one would expect that subjects in the "see word-think picture" and "see picture-think word" groups (i.e., subjects encountering the stimulus in two forms) would have achieved higher mean scores than those in the "see word-think word" and "see picture-think picture" groups. Such was not the case. In fact, subjects whose presentation mode and strategy were in one form only actually scored slightly higher on both the immediate and delayed tests than did those who presumably encountered each stimulus in both forms.

The data indicate that memory is better for pictures than for words, both as actual stimuli and, to a lesser degree, as objects conceptualized for memory purposes. Significant differences favoring pictures over words as the presentation mode were obtained on both the immediate and delayed tests. This finding is generally consistent with the data from previous research on memory for pictures and words. A significant difference favoring the "think picture" strategy over the "think word" strategy was obtained on the immediate test but not on the delayed test. Whereas the significant effect associated with presentation of the stimulus in picture form was strong enough to persist through the delayed test, the effect associated with thinking of the stimulus in picture form was not.

The significant difference at the .01 level favoring the "think picture" strategy over the "think word" strategy on the immediate test, combined with the non-significant difference on the delayed test, seem important as they relate to the effects of memory strategies over time. The present finding is consistent with earlier results obtained by the authors (Sullivan and Filan, 1979, Note 1). In the previous study, a highly significant difference favoring a "think picture" strategy over a "no

strategy" treatment was obtained on an immediate test, followed by a negligible difference between these treatments on a three-day delayed test. The consistency of the findings regarding longer-term memory effects from these two studies raises a serious question about the degree to which experimental memory strategies, such as those used in the studies by the present authors and in much of the recent imagery research, actually result in better memory over an extended time period.

Despite the significant main effect favoring the "think picture" over the "think word" strategy on the immediate test, the "think picture" strategy was not consistently the most effective across all three reading groups. The differential effectiveness of the two strategies is indicated by the memory strategy by reading level interaction on both the immediate and delayed tests. The significant main-effect difference on the immediate test was due to superior performance by the high and middle reading groups under the "think picture" strategy. Ss from the low reading group who had used the "think word" strategy performed slightly better than their "think picture" counterparts on the immediate test (30.75 to 30.62) and substantially better on the delayed test (23.50 to 20.46). Surprisingly, among Ss who had used the "think word" strategy, low readers actually scored slightly higher than high readers (30.75 to 30.42) on the immediate test.

The results of this study clearly indicate, as did the 1979 study by the authors, that the relationship between the form in which the stimulus is initially encountered (i.e., the presentation mode) and the form in which it is recalled (i.e., tested) is a very important factor with respect to memory for the stimulus. Subjects who were presented with stimuli in

picture form performed better on picture items than on word items on both the immediate and delayed tests. Conversely, subjects presented with stimuli in word form performed better on words than on pictures on both tests. This relationship occurred even in cases when the induced memory strategy involved the opposite mode from the mode in which the stimulus was presented. For example, when stimuli were presented in word form but subjects were instructed to "think pictures," subjects still consistently scored higher on word test items than on picture items. In contrast with the clear relationship between presentation mode and test mode, the results did not indicate any important relationship between the form in which stimuli presumably were conceptualized mentally (i.e., "think picture" or "think word") and the form of items on the test.

A potentially promising area for further research on memory strategies relates to the effects of different strategies over time. The authors' research indicates that significant immediate effects associated with use of a mental imagery strategy do not persist in strength, even over a three-day period. It may be unreasonable to expect that longer-term effects will occur when a particular strategy is used for only a few seconds each with a single presentation of each stimulus. Increasing such factors as length of presentation of a stimulus, number of presentations, forms in which the stimulus is encountered, and variety of memory strategies used may be necessary to obtain substantial longer-term effects. Further research aimed at studying such factors and their effects on the memory process should be helpful in promoting our understanding of short-term and longer-term memory.

REFERENCE NOTE

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Table 1

MEAN SCORES ON IMMEDIATE TEST

Presentation Mode	Memory Strategy	Reading Level and Test Mode: High Pics	High Words	Middle Pics	Middle Words	Low Pics	Low Words	Totals Pics	Totals Words	Grand Totals P+W
Pictures	Think Pic	18.83	17.17	18.17	16.92	18.08	14.83	18.36	16.31	34.67
	Think Word	16.92	15.92	17.50	14.92	16.08	14.25	16.83	15.03	31.86
Words	Think Pic	17.17	17.92	14.67	16.92	13.08	15.25	14.97	16.70	31.67
	Think Word	13.50	14.50	14.83	16.58	14.33	16.83	14.22	15.97	30.19
	Totals	16.61	16.38	16.29	16.34	15.39	15.29	16.10	16.00	32.10

Totals for Main Effects: *Reading: Hi = 32.99, Med = 32.63, Low = 30.68; **Pres. Mode: Pics = 33.27, Words = 30.93; **Strat: Think P = 33.17, Think W = 31.03; Test Mode: Pics = 16.10, Words = 16.00

*Significant at .05 level. ** Significant at .01 level

Note: The totals for main effects shown beneath the table for reading level, presentation mode, and memory strategy are mean scores on the 40-item (20 pictures + 20 words) test. Means shown within the table and beneath it for test mode are based on the 20 items in each mode, rather than on 40 items.

N = 144. Cell sizes are 12.

Table 2

MEAN SCORES ON DELAYED TEST

Presentation Mode	Memory Strategy	Reading Level and Test Mode: High Pics	High Words	Middle Pics	Middle Words	Low Pics	Low Words	Totals Pics	Totals Words	Grand Totals P+W
Pictures	Think Pic	15.83	14.00	14.83	13.42	12.83	10.17	14.97	12.53	27.50
	Think Word	13.92	12.92	13.50	12.08	12.58	10.83	13.33	11.94	25.27
Words	Think Pic	11.83	15.17	9.75	12.83	8.50	9.42	10.03	12.47	22.50
	Think Word	9.50	11.83	10.83	13.33	11.25	12.33	10.53	12.50	23.03
	Totals	12.77	13.48	12.23	12.92	11.29	10.69	12.22	12.36	24.58

16 Totals for Main Effects: ***Reading: Hi = 26.25, Med = 25.15, Low = 21.98 ***Pres. Mode: Pics = 26.39, Words = 22.77 Strat: Think P = 25.00, Think W = 24.15 Test Mode: Pics = 12.22, Words = 12.36

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***Significant at .001 Level

Note: The totals for main effects shown beneath the table for reading level, presentation mode, and memory strategy are mean scores on the 40-item (20 pictures + 20 words) test. Means shown within the table and beneath it for test mode are based on the 20 items in each mode, rather than on 40 items.

N = 144. Cell sizes are 12.

Table 3

Source Table for Univariate ANOVA for
Words and Pictures on Immediate and Delayed Tests

Source of Variance		df	MS	Univariate F	p <
Presentation Mode (PM)	W+PI	1	196.00	10.38	.01
	W+PD	1	413.44	15.35	.001
Strategy (S)	W+PI	1	164.70	8.72	.01
	W+PD	1	13.44	.50	ns
Read Level (RL)	W+PI	2	73.05	3.87	.05
	W+PD	2	235.90	8.76	.001
PM x S	W+PI	1	16.00	.85	ns
	W+PD	1	46.69	1.73	ns
PM x RL	W+PI	2	3.06	.16	ns
	W+PD	2	8.97	.33	ns
S x RL	W+PI	2	87.38	4.63	.05
	W+PD	2	163.22	6.06	.01
PM x S x RL	W+PI	2	68.40	3.62	.05
	W+PD	2	55.76	2.07	ns
Test Mode (TM)	W-PI	1	1.36	.23	ns
	W-PD	1	10.03	1.06	ns
PM x TM	W-PI	1	484.00	81.16	.0001
	W-PD	1	544.44	57.42	.0001
S x TM	W-PI	1	.69	.17	ns
	W-PD	1	.11	.01	ns
RL x TM	W-PI	2	.88	.14	ns
	W-PD	2	27.13	2.86	ns
PM x S x TM	W-PI	1	.44	.07	ns
	W-PD	1	10.03	1.06	ns
PM x RL x TM	W-PI	2	21.90	3.67	.05
	W-PD	2	4.17	.44	ns
S x RL x TM	W-PI	2	10.55	1.77	ns
	W-PD	2	2.26	.24	ns
PM x S x RL x TM	W-PI	2	2.84	.48	ns
	W-PD	2	1.38	.15	ns
Between Subj. (Error)	W+PI	132	18.88		
	W+PD	132	26.93		
Within Subj. (Error)	W-PI	132	5.96		
	W-PD	132	9.48		